October 22, 2018

Via Email and First Class Mail

Central Valley Regional Water Quality Control Board
1685 "E" Street
Fresno, CA 93706-2007
Centralvalleyfresno@waterboards.ca.gov

Re: Tentative Resolution R5-2018-xxxx Approving Waiver of Reports of Discharge and Waste Discharge Requirements for Specific Types of Discharge

To Whom It May Concern:

We are writing on behalf of the Center for Biological Diversity (the "Center") to submit the following comments on the Central Valley Regional Water Quality Control Board's ("Regional Board") tentative Resolution R5-2018-xxxx that would renew a five-year waiver for certain types of discharges.

The Center is a national, nonprofit conservation organization with more than 1 million members and online activists dedicated to the protection of natural resources, public health, endangered species and wild places. The Center has many members who reside, work, and engage in recreation in the Central Valley.

The current waiver, which the Regional Board approved pursuant to Resolution R5-2013-0145 in 2013, waives the report of wastewater discharge and waste discharge reporting requirements for drilling muds, drill cuttings, and boring waste from fresh water well drilling. The 2013 Resolution narrowed the waiver to exclude discharges of drilling muds and boring wastes associated with oil and gas operations.

The Regional Board made this change after finding potential "impacts to water quality based on increases in oil and gas drilling in the Central Valley Region over the last five years, advances in oil and gas drilling technologies (e.g., horizontal drilling and well stimulation activities), and increases in the drilling for oil and gas outside of existing oil and gas fields…" [1]

The Center submitted extensive comments during the administrative process in 2013 and provided evidence that the chemicals used in drilling muds, drill cuttings, and boring waste had adverse health and environmental impacts, posing a threat to surface and groundwater. Moreover, many of the chemicals used in the drilling process were unknown at the time. Given the risks, the Regional Board was correct in concluding that the waiver meant for low-risk discharges would be inappropriate and inapplicable to drilling muds, and associated discharges.

We urge the Regional Board to continue to limit the waiver to exempting drilling muds only from fresh water wells. Should the Regional Board consider expanding the waiver to include oil

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[1] Regional Board Resolution R5-2103-0145 (adopted December 5, 2013), Finding 10 at p. 3.

and gas wells, we respectfully request additional time to comment with the proposed language for the waiver available to the public for review. Any expansion of the waiver to apply to oil and gas wells would result in significant environmental impacts, which would be inconsistent with the Porter-Cologne Act, the state's Anti-degradation policy (State Water Resources Control Board Resolution 68-16), potentially multiple water quality control plans, and would at minimum require a full environmental impact report compliant with the California Environmental Quality Act (Pub. Res. Code, §§ 21000 et seq.)

In addition, the Regional Board stated in its previously adopted resolution that "[d]ischarge of drilling muds/boring wastes from oil and gas operations will be considered in a separate action to determine whether or not a waiver of RWDs and/or WDRs is appropriate."[2] Yet we are unaware of any action taken by the Regional Board since 2013 that addresses drilling muds and boring wastes from oil and gas operations. We urge the Regional Board to reexamine the practice of discharging these dangerous wastes in the Central Valley to ensure that the state's groundwater is not being degraded.

We have summarized some of the dangers of drilling muds, drill cuttings, and boring waste below.

Chemicals Used and Their Associated Toxicity

There are dozens of chemical additives in drilling mud (i.e. drilling fluids) that pose potential threats to human health and the environment. These additives fall under various chemical categories depending on whether water-based fluids (WBF) or non-aqueous fluids (NAF) are used, but common additive functions include: density, viscosity, fluid loss, and pH control; salts; biocides; lubricants; dispersants; emulsifiers; and corrosion inhibitors. [3] Chemicals used amongst these categories present risks not only to workers who may handle the chemicals, but also to nearby communities, flora, and fauna that may be exposed to them via air, soil, or groundwater contamination.

These chemicals are associated with a number of negative health effects. In a study of 353 chemicals used in the recovery of natural gas (e.g. drilling and/or fracking), it was found that more than 75 percent of the chemicals could adversely impact the skin eyes and sensory organs; 75 percent could impact the respiratory and gastrointestinal systems; 40-50 percent could impact the nervous, immune, urinary, and cardiovascular systems; 37 percent could impact the endocrine system; and 25 percent could cause cancer and mutations.[4]

For example, bentonite is a chemical used to control drilling fluid viscosity and can, depending on the amount of silica it contains, cause silicosis and lung cancer in those exposed to it.

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[2] R5-2013-0145, Finding 10, p. 3.

[3] International Petroleum Industry Environmental Conservation Association (IPIECA) & Association of Oil & Gas Producers (OGP). Drilling fluids and health risk management: A guide for drilling personnel, managers and health professionals in the oil and gas industry. Report for OGP/IPIECA Health Committee by the Drilling Fluids Task Force. 2009.

[4] Colborn, Theo et al. Natural Gas Operations from a Public Health Perspective. 17 Human and Ecological Risk Assessment 1039. 2011.

Potassium hydroxide, which is used for pH control, is both skin and eye corrosive and, when inhaled, strongly irritating to the upper respiratory tract. Inhalation can even be fatal as a result of spasm, inflammation, and edema of the larynx, bronchi, and lungs. Zinc bromide, a salt, likewise can cause severe irritation of mucous membranes and upper respiratory tract, with symptoms including coughing, wheezing, shortness of breath, headache, nausea, and lung damage at high concentrations. Calcium bromide, a salt and inhibitor, has been linked to slow-healing skin injuries.[5] Skin irritation and inhalation effects are generally common and often instantaneous when dealing with drilling muds due to the low pH (high acidity) fluids used and fine particles that emanate from them. [6]

However, there are other chemicals that can present impacts in the longer-term. In addition to harming the eyes and the respiratory system, the biocide formaldehyde is classified as a cancer-causing substance by the International Agency for Research on Cancer and the California Air Resources Board.[7] Glutaraldehyde, another biocide, is suspected of harming cardiovascular, endocrine, gastrointestinal, immune, reproductive, respiratory, sensory, and urinary systems, along with being a suspected mutagen.[8] Over a million pounds of fluids can be used in a given well drilling event, with many of the herein described toxic chemicals part of the fluid composition[9];chemicals that, given the fluid volume, can easily be mobilized in the event of a spill or improper drilling fluid disposal.

Other health impacts can arise from direct exposure to crude oil. All drilling fluids may be contaminated with crude oil from the drilled reservoir, leading to the presence of chemicals such as the BTEX compounds (benzene, toluene, ethylbenzene, and xylene).[10] This suite of chemicals poses threats to virtually all systems of the human body including the sensory, gastrointestinal, immune, reproductive, cardiovascular, endocrine, and nervous systems.[11] Benzene specifically

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[5]International Petroleum Industry Environmental Conservation Association (IPIECA) & Association of Oil & Gas Producers (OGP). Drilling fluids and health risk management: A guide for drilling personnel, managers and health professionals in the oil and gas industry. Report for OGP/IPIECA Health Committee by the Drilling Fluids Task Force. 2009.

[6] Khodja, Mohamed et al. Chapter 13: Drilling Fluid Technology: Performances and Environmental Considerations in Products and Services: from R&D to Final Solutions edited by Igor Fuerstner. 2010.

[7] *See e.g.*, Environmental Protection Agency. (n.d.). Formaldehyde hazard summary. https://www.epa.gov/sites/production/files/2016-09/documents/formaldehyde.pdf; IARC. Formaldehyde. https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100F-29.pdf; California Air Resources Board. Formaldehyde. https://www.arb.ca.gov/research/indoor/formaldehyde.htm (last visited October 16, 2018).

[8] The Endocrine Disruption Exchange. Crosby Well 25-3 Drilling Chemicals Spreadsheet. 2009. https://endocrinedisruption.org/assets/media/documents/CrosbyWell4-12-09.xls.

[9] South Coast Air Quality Management District. Rule 1148.2 Oil and Gas Well Electronic Notification and Reporting, Public Information Portal (Last updated: October 2018). http://www.aqmd.gov/home/rules-compliance/compliance/1148-2.

[10] IPIECA & OGP. Drilling fluids and health risk management: A guide for drilling personnel, managers and health professionals in the oil and gas industry. Report for OGP/IPIECA Health Committee by the Drilling Fluids Task Force. 2009, p. 9.

[11] Agency for Toxic Substances and Disease Registry (ATSDR), ATSDR A-Z Index, https://www.atsdr.cdc.gov/az/a.html (last visited on October 15, 2018) (“ASTDR A-Z Index”).

has been consistently linked to cancer while toluene has been linked to reprotoxicity.[12] Such health risks are made even more daunting by the fact that they can arise or persist years after chemical exposures. Because of this, both the International Association of Oil & Gas Producers (OGP) and the International Petroleum Industry Environmental Conservation Association (IPIECA) recommend that every drilling company keep medical records for 40 years after an individual leaves employment.[13]

Types of Drilling Fluids

Workers may face the highest health risks from drilling fluid contacts, but there are risks posed to the population at-large and the surrounding environment as well. The risks depend in part on the type of drilling fluid used: water-based fluid (WBF), oil-based fluid (OBF), or synthetic-based fluid (SBF) (with OBF and SBF both non-aqueous fluids [NAF]).

In terms of fluid composition, the types of fluids in order of least to most risk posed are water-based fluids, synthetic-based fluids, and oil-based fluids.[14] Water-based fluids, by definition, have water as the base (either freshwater, seawater, or brine) at approximately 76% water, 14% barite, 6% clay/polymer, and 4% other. Oil-based fluids meanwhile are 46% non-aqueous fluid, 33% barite, 18% brine, 2% emulsifiers, and 1% gellants/other. The non-aqueous fluid of oil-based fluids contains varying amounts of aromatic hydrocarbons in the form of mineral oil, diesel, or crude oil, which themselves contain polycyclic aromatic hydrocarbons (PAHs). PAHs have been linked to genetic mutations, cancer, and harmful effects on skin, body fluids, and the immune system.[15]

OBFs surpass the other two types drilling fluids in terms of risk in a number of categories. In both the stages of drilling and the transport of drilling fluids, OBFs pose the greatest risk in terms of the potential for occupational chemical exposures and environmental spills. With the onshore disposal of drilling fluids, OBFs present the greatest risks across multiple categories, including occupational, public, and environmental impacts. However, it is important to note the WBFs pose greater risks in some categories than the other two fluid types, namely the potential for occupational accidents during drilling, and the potential for public and environmental contamination via air emissions. WBFs are used 90-95% of the time, so much of the risk associated with WBFs may be from frequency of use.[16]

When drilling in shale, using WBFs is often ineffective, and can lead to fluid moving into the shale and destabilizing it to the point of collapse. When this happens, it can be difficult to

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[12] IPIECA & OGP. Drilling fluids and health risk management: A guide for drilling personnel, managers and health professionals in the oil and gas industry. Report for OGP/IPIECA Health Committee by the Drilling Fluids Task Force. 2009.
[13] *Id.*
[14] Sadiq, Rehan et al. Evaluation of generic types of drilling fluids 32 Environmental Management 778. 2003.
[15] Agency for Toxic Substances and Disease Registry (ATSDR), ATSDR A-Z Index, https://www.atsdr.cdc.gov/az/a.html (last visited October 15, 2018) ("ASTDR A-Z Index").
[16] Khodja, Mohamed et al. Chapter 13: Drilling Fluid Technology: Performances and Environmental Considerations in Products and Services: from R&D to Final Solutions edited by Igor Fuerstner. 2010.

prevent the WBFs from leaching into the surrounding soil and water.[17] So in drilling shale, OBFs are often preferred, despite the added risk noted above. In response to the threats posed by OBFs, SBFs were developed to provide performance characteristics comparable to traditional OBFs with the lower environmental impacts and greater worker safety of WBFs.[18] However, SBFs are most often reserved for offshore drilling operations.[19]

Risks to Soil and Groundwater

Environmental risks associated with drilling muds are still a burgeoning area of research, but the studies that do exist indicate adverse impacts on environmental quality and wildlife. It is believed that chronic and sublethal exposure to drilling muds can cause not only toxic mortality, but also behavioral, physiological and biological alterations of biota.[20] Furthermore, drilling muds are high in salts and sodium content, and it has been suggested that such muds could inhibit plant growth. Exposures to drilling muds can most directly occur via soil and water resource contamination, putting the life exposed to these media in jeopardy.

For instance, in a study of Padres Island, Texas, it was found that soils had elevated levels of drilling fluid-associated constituents including the heavy metals barium, chromium, lead, and zinc. Heavy metals are potentially toxic to soil microbes and have been shown to have effects on their diversity and lifespan in quantities as small as 1 ppm.[21] Elevated levels of sodium, salinity, pH, and petroleum hydrocarbons were also found. While the levels of these constituents were not found to pose immediate environmental threats, long-term cumulative effects of soil alteration on organisms and habitats were not ruled out. Long-term cumulative effects are probable considering that some previously-abandoned sites in the study area had petroleum substances that had persisted for more than a decade in soils.[22]

Another study, conducted in the Niger Delta, likewise found elevated concentrations of heavy metals (lead, cadmium, iron, and chromium) in excess of toxicity limits for heavy metals in natural soil. This study also found groundwater contamination in the delta in the form of lead concentrations and pH values that deviated significantly from the World Health Organization

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[17] Sadiq, Rehan et al. Evaluation of generic types of drilling fluids 32 Environmental Management 778. 2003.
[18] U.S. Environmental Protection Agency. Development document for final effluent limitations guidelines and standards for synthetic-based drilling fluids and other non-aqueous drilling fluids in the oil and gas extraction point source category. Washington DC, EPA-821-00-013. 2000. https://www.epa.gov/sites/production/files/2015-06/documents/og_sbf_dd_final_2000.pdf.
[19] *Id.*
[20]Carls, E. G. et al. Soil Contamination by Oil and Gas Drilling and Production Operations in Padre Island National Seashore, Texas, U.S.A. 45 Environmental Management 273. 1995.
[21] Sobolev, Dmitri & Maria F. T. Begonia. Effects of Heavy Metal Contamination upon Soil Microbes: Lead-induced Changes in General and Denitrifying Microbial Communities as Evidenced by Molecular Markers. 5 Environmental Public Health and Research 450. 2008.
[22]Carls, E. G. et al. Soil Contamination by Oil and Gas Drilling and Production Operations in Padre Island National Seashore, Texas, U.S.A. 45 Environmental Management 273. 1995.

standard for potable water. It was concluded that drilling muds were the probable cause of the heavy metal soil and groundwater contamination.[23]

In a third study in which different doses of drilling fluids or crude oil were applied to clean soils, it was found that both plant densities and crop yields (wheat, barley, soy) were impacted.[24] In the first year of the study, it was found that in treatments with higher drilling mud exposures, wheat crop emergence was much poorer compared to treatments with lower drilling mud exposure. Two reasons were proposed for this: (1) Higher contamination by petroleum hydrocarbons caused a thin film to form around the seed germ, which choked the seed of oxygen and caused plant embryo death and (2) The petroleum hydrocarbon-contaminated soil was more compact and less moist than the control, and had a higher content of toxic substances unsuitable for the plant. In general, plants grown under conditions of drilling fluid or crude oil exposure had both lower plant densities and crop yields than the control in which no fluids were applied.

The Endocrine Disruption Exchange conducted a study of the products and chemicals used in drilling a natural gas well in Park County, Wyoming, which led to a spill in August 2006. As a result of a breach in the surface casing for this well, natural gas, petroleum condensate, and drilling fluids were accidentally released to the surface. This release occurred over the course of 58 hours between August 11 and August 13, and impacted soils over an area of 25,000 square feet. This release involved 32 chemicals, with 22 having CAS numbers for identification. Of those 22 chemicals, 100 percent were associated with respiratory effects, 90 percent with skin, eye and sensory organs impacts, 77 percent with damage to the gastrointestinal system or liver, 55 percent with immune system damage, and 50 percent with ecological effects such as potential harm to aquatic species, birds, amphibians, or invertebrates. There were also chemicals associated with cancer, organ damage, developmental effects, and reproductive harms. Twelve of the chemicals with CAS numbers were water soluble, while seven were volatile, with the result being chemicals that posed threats to both air and water resources.[25]

Yet another study tested the impact of drilling muds on three fish types: freshwater, marine, and benthic (bottom-dwelling) marine.[26] In this laboratory study to determine the lethal concentration of drilling mud for fish, a significant difference in mortality was observed between control and test concentrations. Mortality rate increased with increasing concentration of chemicals. The conclusion was that the chemicals in drilling muds are toxic to aquatic life. Interestingly, the study also found that non-aqueous drilling fluids were more biodegradable in aquatic settings

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[23] Asia, I.O. et al. The effects of petroleum exploration and production operations on heavy metals contents of soil and groundwater in the Niger Delta. 2 International Journals of Physical Sciences 271. 2007.

[24] Kisic, I. et al. The effect of drilling fluids and crude oil on some chemical characteristics of soil and crops. 149 Geoderma 209. 2009.

[25] The Endocrine Disruption Exchange. Analysis of Products Used for Drilling Crosby 25-3 Well – Windsor Energy, Park County, Wyoming. 2009. https://endocrinedisruption.org/assets/media/documents/Crosby%2025-3%20well%20summary%208-3-17.pdf.

[26] Sil, A. et al. Toxicity Characteristics of Drilling Mud and Its Effect on Aquatic Fish Populations. 16 Journals of Hazardous, Toxic, and Radioactive Waste 51. 2012.

than water-based fluids.[27] Thus, although NAFs may contain more toxic chemicals (e.g. aromatic hydrocarbons)[28] than WBFs, WBFs may have more persistence in the environment under certain scenarios, leading to longer-lasting threats.

Implications for Human and Environmental Health

There are numerous chemicals in drilling fluids that pose threats to human and environmental health, both in the form of additives and chemicals directly associated with crude oil and gas. While the precise risks vary depending on the type of drilling fluid employed, there are clear pathways for toxic chemicals from drilling muds to reach both soils and water resources. This puts those exposed to such soils and water resources in peril, including the plants growing in the soils that rely on the water, the fish that live in the water, and the people and wildlife who eat the plants growing in the soils and who drink the water. Thus, it is important to have a full grasp of when and where drilling fluids are being discharged, and to control those discharges to preserve public and environmental well-being.

Conclusion

Given the risks posed by chemicals used in drilling operations, we ask the Regional Board to continue to limit the waiver to exempting drilling muds only from fresh water wells. We also urge you to take additional steps to protect the state's water resources by addressing the dangers of drilling muds and boring waste from oil and gas operations.

Respectfully submitted,

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[27] *Id.*
[28] *See e.g.*, IPIECA & OGP. Drilling fluids and health risk management: A guide for drilling personnel, managers and health professionals in the oil and gas industry. Report for OGP/IPIECA Health Committee by the Drilling Fluids Task Force. 2009.

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